

1 What is claimed is:

2 1. An electrically programming & sensing unit for a field repairable system-on-a-
3 chip (SOC) device, said electrically programming & sensing unit comprising:

4 a diode such that a cathode of said diode is connected to a VDD power;

5 an electrically programmable element with a first end connected to an anode of said
6 diode and to a VPP power;

7 a pull-down transistor configured to conduct current from said VDD power or from
8 said VPP power to ground through said electrically programmable element when turned on;

9 a latch configured to latch a value from a second end of said electrically
10 programmable element; and

11 a multiplexor configured to receive a set of external inputs and to control the
12 operation of said pull-down transistor based on said set of external inputs.

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14 2. The electrically programming & sensing unit of claim 1, wherein said
15 electrically programmable element has an initial state that is one of a high resistance and a
16 low resistance and has a programmed state that is the other of said high resistance and said
17 low resistance.

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19 3. The electrically programming & sensing unit of claim 2, wherein a turn-on
20 resistance of said pull-down transistor is substantially at least 10 times of said low resistance
21 and is substantially at maximum 1/10th of said high resistance.

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1 4. An electrically programmable circuit for a field repairable system-on-a-chip
2 (SOC) device, comprising:

3 a high voltage generator configured to supply a VPP power in response to a
4 program_enable signal;

5 a scan chain configured to receive address bits indicating whether a redundant row or
6 a column needs to be activated;

7 an electrically programming & sensing unit configured to receive a signal from said
8 scan chain, said program_enable signal, and a power-on-reset signal such that upon activation
9 of said program_enable signal, said electrically programming & sensing unit further
10 configured to be programmed in response to said signal from said scan chain indicating a
11 defective row or column should be fixed; and

12 a fuse-switch configured to receive an output of said electrically programming &
13 sensing unit such that said electrically programming & sensing unit is able to
14 activate/deactivate said fuse-switch.

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16 5. The electrically programmable circuit of claim 4, further comprises a feedback
17 connection from an output of said electrically programming & sensing unit to said scan chain.

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19 6. The electrically programmable circuit of claim 4, wherein said electrically
20 programming & sensing unit comprises:

21 a diode such that a cathode of said diode is connected to a VDD power;

22 an electrically programmable element with a first end connected to an anode of said
23 diode and to said VPP power;

1 a pull-down transistor configured to conduct current from said VDD power or from
2 said VPP power to ground through said electrically programmable element when turned on;

3 a latch configured to latch a value from a second end of said electrically
4 programmable element; and

5 a multiplexor configured to:

6 receive said program_enable signal and said signal from said scan chain; and
7 output a signal which follows said signal from said scan chain to said pull-
8 down transistor upon activation of said program_enable signal.

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10 7. The electrically programmable circuit of claim 6, wherein said multiplexor is
11 further configured to:

12 receive said power-on-reset signal; and
13 output a signal which follows said power-on-reset signal to said pull-down transistor
14 upon deactivation of said program_enable signal.

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16 8. The electrically programmable circuit of claim 6, wherein said electrically
17 programmable element has an initial state that is one of high resistance and low resistance
18 and has a programmed state that is the other of said high resistance and said low resistance.

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20 9. The electrically programmable circuit of claim 8, wherein a turn-on resistance
21 of said pull-down transistor is substantially at least 10 times of said low resistance and is
22 substantially at maximum 1/10th of said high resistance.

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1 10. The electrically programmable circuit of claim 6, wherein said pull-down
2 transistor is an NMOS transistor

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4 11. The electrically programmable circuit of claim 4, wherein said fuse-switch
5 comprises:

6 a fuse; and

7 a transistor configured to conduct current through said fuse when activated.

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9 12. The electrically programmable circuit of claim 11, wherein said transistor of
10 said fuse-switch is one of NMOS, PMOS, and bipolar transistor.

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12 13. The electrically programmable circuit of claim 4, wherein said scan chain
13 comprises a plurality of flip-flops.

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15 14. A field-repairable system-on-a-chip (SOC) device, comprising:
16 at least one of a plurality of redundant rows and a plurality of redundant columns,
17 wherein each of said redundant row or said redundant column includes a plurality of fuse
18 boxes;
19 a plurality of usage indicators configured to indicate that corresponding redundant
20 rows or corresponding redundant columns are in use;
21 a fuse map sensing circuit configured to sense and save data of said plurality of usage
22 indicators; and
23 a fuse map scan chain configured to send out data sensed by said fuse map sensing
24 circuit.

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2 15. The field-repairable SOC device of claim 14, wherein each of said fuse boxes
3 for said redundant rows and said redundant columns includes:

4 a fuse-switch; and

5 an electrically programming & sensing unit configured to control said fuse-switch.

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7 16. The field-repairable SOC device of claim 14, wherein each of said usage
8 indicators comprises a fuse.

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10 17. The field-repairable SOC device of claim 14, wherein said fuse mapping
11 circuit comprises:

12 a latch configured to latch value of said usage indicator; and

13 a transistor configured to cause said latch to latch the value of said usage indicator.

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15 18. The field-repairable SOC device of claim 14, further comprising:

16 a high voltage generator configured to supply a VPP power in response to a
17 program_enable signal;

18 a scan chain configured to receive address bits indicating of word and bit lines that
19 should be corrected; and

20 a plurality of electrically programmable circuits, wherein each of said electrically
21 programmable circuit comprises:

22 an electrically programming & sensing unit configured to receive a signal
23 from said scan chain, said program_enable signal, and a power-on-reset signal such
24 that upon activation of said program_enable signal, said electrically programming &

1 sensing unit further configured to be programmed in response to said signal from said
2 scan chain indicating a defective row or column should be fixed; and
3 a fuse-switch configured to receive an output of said electrically programming
4 & sensing unit such that said electrically programming & sensing unit is able to
5 activate/deactivate said fuse-switch.

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7 19. The field-repairable SOC device of claim 18, wherein said electrically
8 programming & sensing unit comprises:

9 a diode such that a cathode of said diode is connected to a VDD power;
10 an electrically programmable element with a first end connected to an anode of said
11 diode and to said VPP power;

12 a pull-down transistor configured to conduct current from said VDD power or from
13 said VPP power to ground through said electrically programmable element when turned on;
14 a latch configured to latch a value from a second end of said electrically
15 programmable element; and

16 a multiplexor configured to:

17 receive said program_enable signal and said signal from said scan chain; and
18 output a signal which follows said signal from said scan chain to said pull-
19 down transistor upon activation of said program_enable signal.

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21 20. The field-repairable SOC device of claim 19, wherein said multiplexor is
22 further configured to:

23 receive said power-on-reset signal; and

output a signal which follows said power-on-reset signal to said pull-down transistor upon deactivation of said program_enable signal.

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4 21. A method to package a field-repairable system-on-a-chip (SOC) device at a
5 factory, comprising:

6 repairing said SOC device, using one or both of redundant rows and columns, prior to
7 packaging said device;

8 marking usage of all redundant rows and columns;

9 retesting said SOC device; and

10 packaging said SOC device in response to said SOC device completing said retesting
11 step satisfactorily.

13 22. The method of claim 21, wherein said repairing step comprises performing
14 laser blown repairs on said redundant rows and columns.

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16 23. The method of claim 21, wherein said marking step comprises blowing usage
17 indicators corresponding to said redundant rows and columns.

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19 24. A method to field repair a field-repairable system-on-a-chip (SOC) device at a
20 factory, comprising:

21 performing a diagnostic test on said SOC device;

22 identifying unused redundant rows and columns;

23 electrically programming any of said unused redundant rows and columns; and

24 retesting said SOC device.

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2 25. The method of claim 24, further comprising usage marking any used
3 redundant rows and columns during the electrically programming step.

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5 26. The method of claim 24, wherein said electrically programming step
6 comprises:

7 shifting in an address of a defective row or column to a scan chain; and

8 applying a programming power VPP to a electrically programming and sensing unit
9 associated with said address shifted in said scan chain.